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(54) Laying cables

(57) A cable (C) is laid in a pipeline (10) by pushing the cable through a hydraulically variable diaphragm in an inlet tube (11). The end (C') of the cable has collapsible moulded cups (20) attached which can be pushed through the diaphragm and which erect themselves to act as a drag inducing device so that flowed liquid in the pipeline can be used to pull the cable towards an exit tube (12) downstream. A cable pusher (13) pushes the cable through the inlet (11). The cable has a specific gravity less than the liquid, preferably 0.7, which is substantially pressure independent.

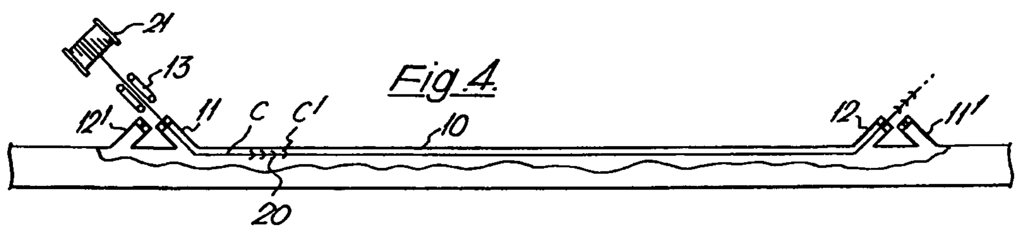

Fig.4.

The drawing(s) originally filed was/were informal and the print here reproduced is taken from a later filed formal copy.

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Fig. 1.

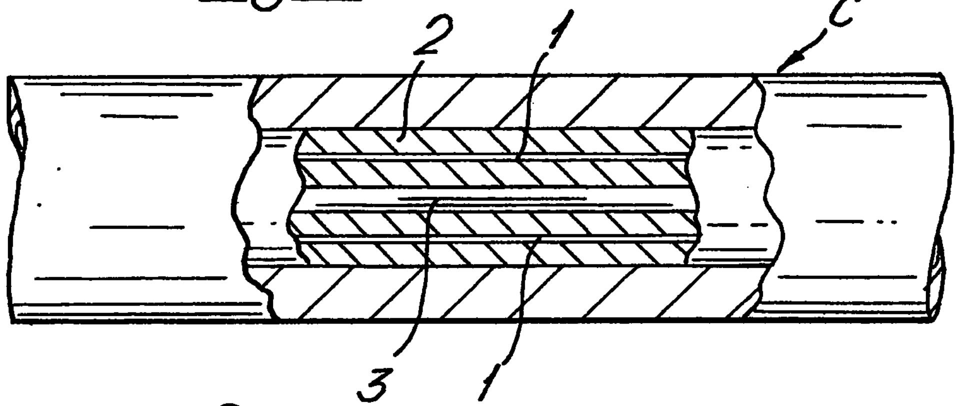


Fig. 2.

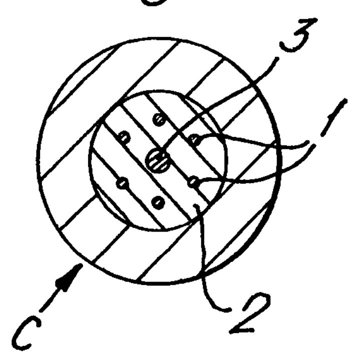


Fig. 3.

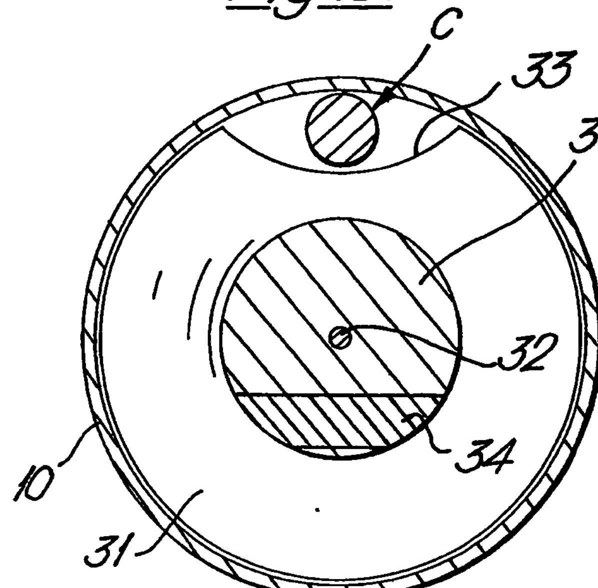
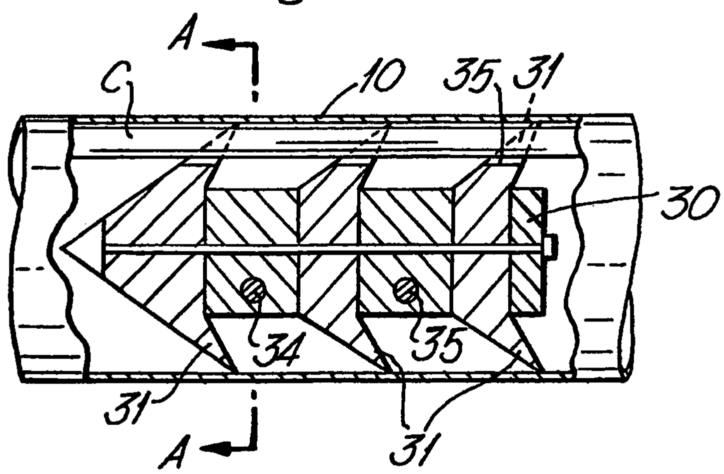


Fig. 3A.



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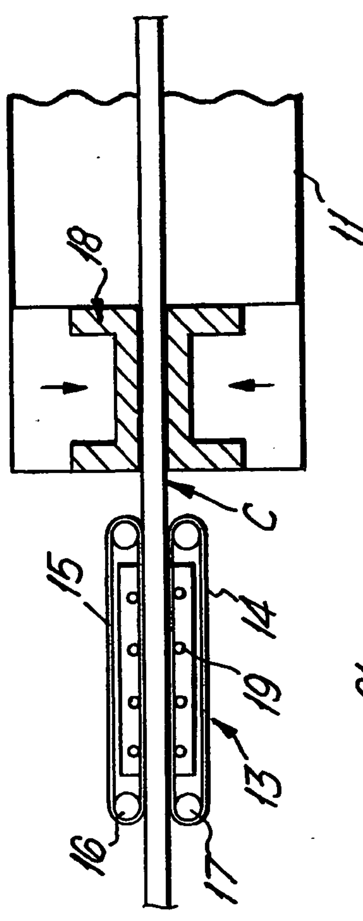

Fig.6.

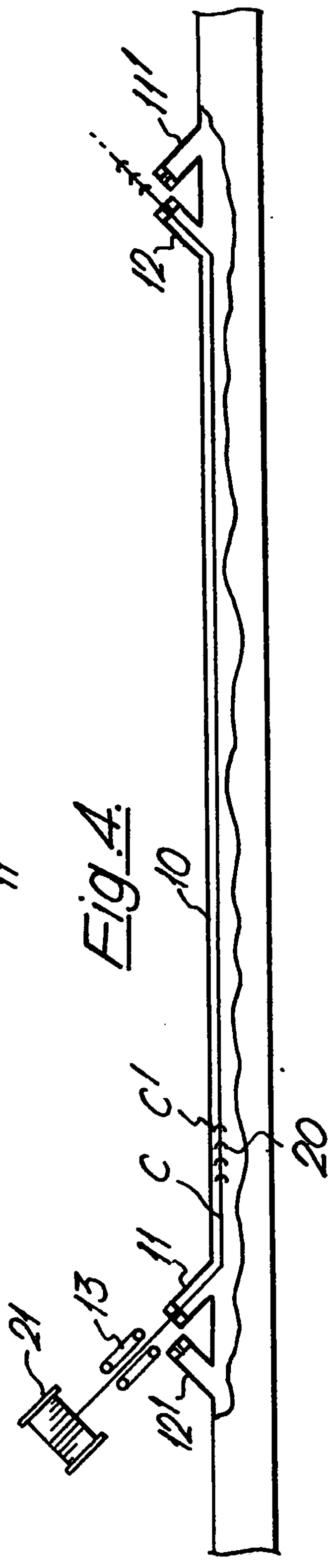

Fig.4.

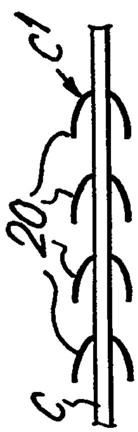

Fig.5.

SPECIFICATION

Laying cables

This invention relates to laying cables in liquids particularly but not exclusively water.

There are certain circumstances under which it is required to lay cables in a duct or pipe which contains liquid and the present invention is concerned with overcoming problems which may arise in such environments.

According to the present invention a communication cable is laid in a duct or pipe containing liquid and has a specific gravity which is less than the liquid so that it floats on the liquid.

According to a further aspect of the invention there is provided a communication cable for laying in a pipeline containing liquid, the cable having a low density layer which renders it to float on the liquid, the cable density being substantially pressure independent.

Preferably the specific gravity of the cable lies in the range 0.5 to 0.9 that of the liquid, preferably 0.7.

Preferably the cable comprises one or more optical fibres surrounding a central strain member and enclosed in a solid plastics jacket which in turn is surrounded by a foamed plastics jacket, such as a syntactic foam.

Where the cable is laid in a pipeline containing liquid and which is required to be cleaned using a pig, the pig has a slot on one side large enough for the pipe to clean it without damaging the cable and without causing the cable to become jammed between the pig and the pipe wall.

According to another aspect of the invention the cable is laid in a pipeline while the pipeline contains a pressurised working liquid and is inserted through the pipeline wall via a valve and has a drag inducing device whereby the liquid will carry the cable in the direction of liquid flow.

Initially the cable is pushed throught the valve from outside the pipeline and can continue to be pushed during the laying operation although under some circumstances the drag inducing device may itself draw the cable throught the valve under the action of the working liquid.

In one embodiment the drag inducing devices comprise a plurality of moulded cups or "umbrellas" attached to the surface of the cable and which are flexible so that they collapse during passage throught the valve and are resilient so that they erect themselves once inside the pipeline or are erected by the force of fluid under them.

In order that the invention can be clearly understood reference will now be made to the accompanying drawings in which:-

Figure 1 is a l ngitudinal secti n f a fibr ptic cabl according t an embodiment of the present invention;

Figure 2 is a transverse cross section of the cable of Figure 1;

Figure 3 shows schematically a cross secti n through a pipeline in which the cable of Figure 1 has been laid, together with a cleaning pig,;

Figure 3A shows a longitudinal section of the pig P of Figur 3;

Figure 4 shows schematically a pipeline in which the cable of Figure 1 is b ing laid;

Figure 5 shows schematically part of the cable of Figure 4 on a larger scale and

Figure 6 shows a detail of Figure 4 on a larger scale.

Referring to Figures 1 and 2, the cable C comprises eight optical fibres 1 embedded in polyethylene 2 around a king wire 3 of high strength plastics material such as Kevlar. It could alternatively be a metal wire. The optical fibres become partially embedded in the polyethylene 2a which is softened by heat allowing the optical fibres to form the interstices and just touch each other and the central strength member. Subsequently a polyethylene jacket 2b is extruded over, entering the outer interstices of the optical fibres and forming a solid polyethylene package with embedded optical fibres.

Such a cable as described thus far can be made by the arrangment and method described in our copending application (L.R. Spicer - 26) and would have a specific gravity greater than unity so that it would sink in water. The cable is completely solid with no voids.

Over the polyethene 2 is extruded a pressure independent syntactic foam sheath 4 which has a specific gravity significantly less than that of water and gives the cable an overall specific gravity of around 0.7. It would however be possible to have a greater or lesser specific gravity by changing the density of the syntactic foam or by making the syntactic foam proportion of the cable larger or smaller accordingly, if preferred.

A syntactic foam extrusion comprises e.g. polymethane mixed with tiny hollow glass spheres 5 which have a constant specific gravity with pressure, e.g. for example 1000 lbs/sq.inch; this mixture is applied to an extruder or continuous moulder, preferably with no moving parts so that the glass spheres are not damaged, and the cable is passed through the extruder to receive the buoyant extruder jacket, commonly referred to as a syntactic foam extrusion. In the embodiment described the cable polyethylene 2 would have an outer diameter of about 0.3 inches, the outer diameter of the syntactic foam being about 0.4 inches.

It is proposed to lay the cable in a liquid-filled pipeline even while the pipeline is in use to transport the liquid, and reference to Figures 4, 5 and 6 will show how this is to be accomplished.

The pipeline 10 has an oblique inlet tube 11 and an outlet tube 12 and the inlet and outlet are spaced say one or two kilometers apart. The inlet tube 11 is shown in greater detail in Figure 6 and has a variable aperture through which the cable C is pushed by a cat rpillar push r 13. This compris s two rubber tracks 14 and 15 which ar driv n by driv whe ls 16 and 17 over sets of support wheels 18 and 19 that squeeze the tracks and push the cable through the inlet tub 11.

The variable aperture is formed by an hydraulically pressurised diaphragm whose aperture is variable in size by varying the hydraulic pressure applied. Thus th entry for th cable through the diaphragm

can be adjust d to just fit th cable C to minimis leakag of liquid out fr m the pipeline.

Attach d to th cabl nd C' is a set of m uld d cups 20 which are moulded onto or otherwise attached to the outer sheath of the cable C. They act in the manner of an umbrella so that they collapse when squeezed by the caterpillar pushed and when pushed through the aperture of the variable diaphragm 18. The cups erect themselves, or are erected by the flow of liquid in the pipeline from the inlet 11 towards the outlet 13, and thus the flow of liquid "carries" the end portion C' of the cable C through the inlet diaphragm by the caterpillar pusher. The cable is unwound from a reel 21.

When the C' of the cable is just short of the outlet 12, the outlet, which has a diaphragm similar to the diaphragm 18 on the inlet, is opened and the flow of liquid, through the outlet carries the cable end C' out through the outlet. The outlet diaphgram is then closed again and either connected to a transmission terminal or to the end of another cable which has been laid through the adjacent inlet 11' along the next adjacent length of pipeline. It could be connected directly to the other cable or via a regenerator for regenerating the information signals carried by the optical fibres.

In some circumstances it may be necessary to have cups 20 which are larger than those shown. In fact they could be same size as the internal bore of the pipeline if for example the flow of liquid is small. Then the cups would act as a "pig" and be driven at substantially the same speed as the liquid with small leakage past the cup peripheries.

In some circumstances it will be necessary to periodically clean the pipeline while the cable is in situ. For this purpose a specially-designed "pig" P is shown in Figure 3. Referring to Figures 3 and 3A the pig comprises a polymethane moulded body shaft 30, and three polymethane moulded cups 31. The shaft and cups are held together by a bolt and nut 32 and the peripheries of the cups have a shallow slot 33 so that the floating cable C will not be touched by the pig. To ensure that the pig remains in the pipe with the slot 33 uppermost, the pig is ballasted with two heavy slugs 34 and 35.

Figure 3 shows the pig P fitted in a pipeline such as the pipeline 10 of Figure 4 with the cable C in place.

CLAIMS

1. A communication cable laid in a pipeline containing liquid, the cable having a specific gravity less than that of the liquid so that the cable floates on the liquid in the pipeline.

2. A communication cable for laying in a pipeline containing liquid, the cable having a low density layer which renders it to fl at on the liquid, th cable density being substantially pressure ind p nd nt.

3. A cabl as claim d in claim 2 wherein th lay r contains discr te lightweight particles.

4. A cable as claimed in claim 2 or claim 3, wherein th layer is a sh ath on the outside of th cable.

5. A cabl as claimed in claim 3 or claim 4, wherein th lay r is a pressure ind p ndent syntactic foam.

6. A cable as claimed in any of claims 2 to 5, wherein th sp cific gravity lies in the range 0.5 to 0.9.

7. A cable as claimed in claim 6, wherein the specific gravity is about 0.7.

8. A cable as claimed in any preceding claim comprising one or more optical fibres.

9. A cable substantially as hereinbefore described with reference to and as illustrated in Figures 1 and 2 modified or not as shown in Figure 5.

10. A pipeline containing a cable as claimed in any of claims 2 to 9 inclusive.

11. A method of laying a communications cable in a pipeline comprising inserting into the pipeline one end of the cable and causing fluid flowing through the pipeline to pull the cable in the direction of fluid flow by means of a drag-inducing device attached to the cable end.

12. A method as claimed in claim 11 wherein the cable has a specific gravity lower than the liquid.

13. A method as claimed in claim 11 or claim 12, wherein the cable is pushed into the pipeline until the end reaches an outlet point on the pipeline where the cable is to emerge.

14. A method as claimed in claim 11, 12 or 13, wherein the cable enters and/or leaves the pipeline through a variable-diameter diaphragm which is controllable by adjusting a fluid pressure in the diaphragm.

15. A method as claimed in any of claims 11 to 14, wherein the drag inducing device comprises flexible cups which collapse during entry into or exit from the pipeline but which become erect inside the pipeline.

16. A method of deploying a cable in a pipeline substantially as hereinbefore described with reference to the accompanying drawings.

17. A method of cleaning a pipeline containing a cable floating on liquid, comprising forcing along the pipeline a pig having a slot in its edge bigger than the cable and having ballast so that the slot remains aligned with the cable during cleaning.

18. A pig for cleaning a pipeline having a cable laid therein, the pig having a slot in its edge larger than the cable, the pig being ballasted so that the pig maintains constant orientation with the slot over the cable.

19. A pig substantially as hereinbefore described with reference to Figures 3 and 3A of the accompanying drawings.

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